Encl. (2) to 69RC0367

TAMM 9115-4TU

# ROTATING AND POSITIVE DISPLACEMENT PUMPS FOR LOW THRUST ROCKET ENGINES

MONTHLY TECHNICAL PROGRESS NARRATIVE NO. 6
FOR PERIOD FROM 1 DECEMBER 1968 TO 31 DECEMBER 1968

by

C. A. MacGregor

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONTRACT NAS 3-12022

(NASA-CR-101308) ROTATING AND POSITIVE DISPLACEMENT PUMPS FOR LOW THRUST ROCKET ENGINES Monthly Technical Progress Report, 1-31 Dec. 1968 (Rocketdyne) 18 p
N84-75595
Unclas
00/20 22756

23 January 1969

NASA Lewis Research Center
Cleveland, Ohio 44135

W. Britsch

RECEIVED
NASA STI FACILITY
INPUT BRANCH
JAN 1969

ROCKETDYNE
A Division of North American Rockwell Corp.
Canoga Park, California

OCT 1984
RECEIVED
NASA STI FACILITY
ACCESS DEPT.

# I. INTRODUCTION

The purpose of this program is to evaluate the use of pumps for application to relatively low thrust (1,000 - 10,000 lb) high specific impulse (400 sec) rocket engines in upper stages utilizing high energy space-storable propellant combinations. The scope of the program consists of Task I, evaluating various concepts of small lightweight efficient rotating and positive displacement pumps and selecting, on the basis of this evaluation, a single rotating and a single positive displacement design; Task II, design and detailing of the two selected pump concepts; Task III, fabrication and assembly of the designs of Task II; and Task IV, evaluation of the two pump designs utilizing both $LN_2$ and $LF_2$.

## II. PROGRESS

The rotating pump design was completed and the required design information was transmitted to the NASA Lewis Research Center project manager for approval. The work initiated as a result of the NASA review to examine higher speed designs of the gear pump and piston pump was completed and the results were sent to the NASA Lewis Research Center project manager for review and a decision on the type of positive displacement pump to design, fabricate, and test.

Under reporting category 2, Positive Displacement Pump Evaluation, the preliminary layout of the 6000 rpm gear pump was completed and is shown in Figure 1. Weight of this configuration is approximately 11.9 pounds. A higher speed design (8000 rpm) which requires a boost pump to satisfy the pump inlet conditions is shown in Figure 2. Optimizing this design to 85% efficiency would result in a pump speed of 9000 rpm, a 1.40 inch gear tip diameter, a 0.3 inch gear width and pump weight of approximately 11.6 pounds.

Considering the pump by itself, the reduction of 0.3 pounds for the boost pump configuration would not justify its selection. It should be noted, however, that the weight of the drive unit may be reduced at the higher speed; and, therefore, this should be taken into consideration in the selection of the configuration. The completion of the above effort and the transmission of the data to the NASA Lewis Research Center project manager completes reporting category 2, Positive Displacement Pump Evaluation.

Under reporting category 3, Rotating Pump Design, the final design of the rotating pump was completed and a layout of the final configuration is shown in Figure 3. The final layout along with design data such as material selection, dimensions, and tolerances and surface finishes where applicable was submitted to the NASA Lewis Research Center project manager for approval.

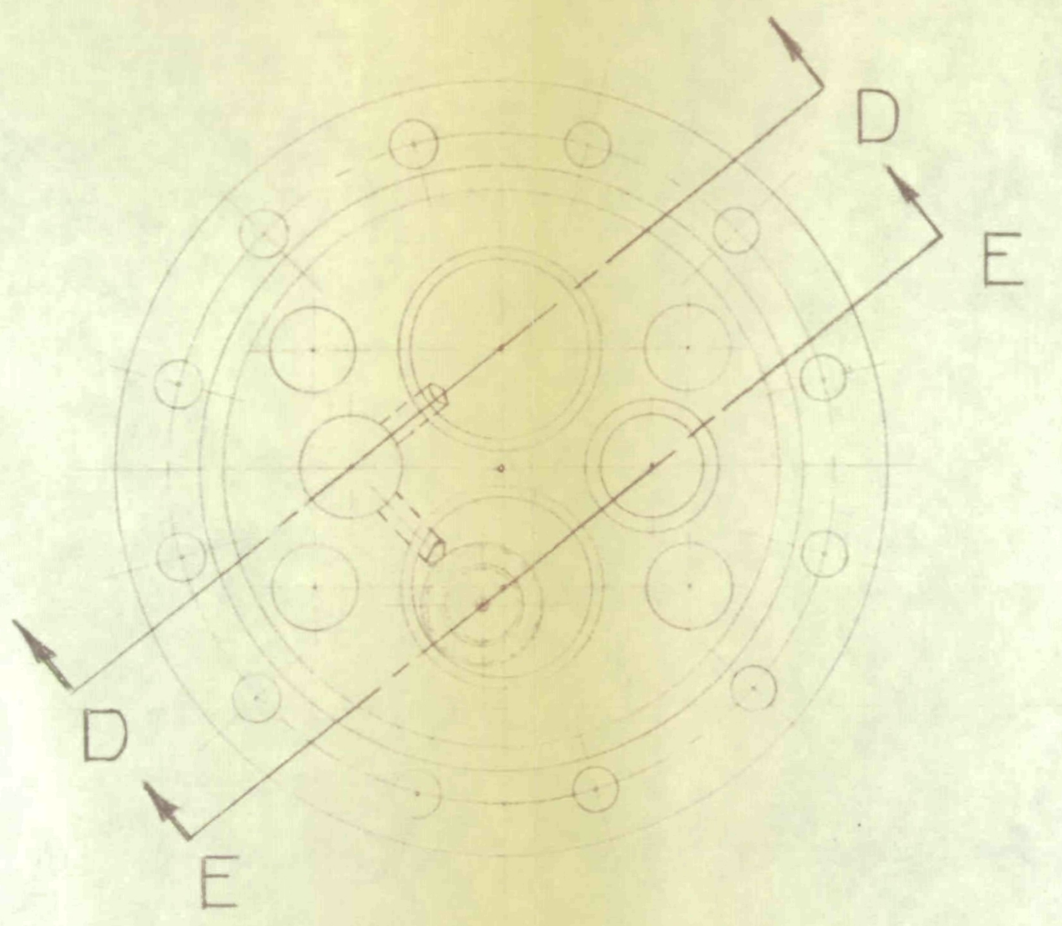
In an effort to maintain schedules, work was initiated on the detail drawings of the major long lead components such as the pump inducer and the pump impeller.

## III. CURRENT PROBLEMS

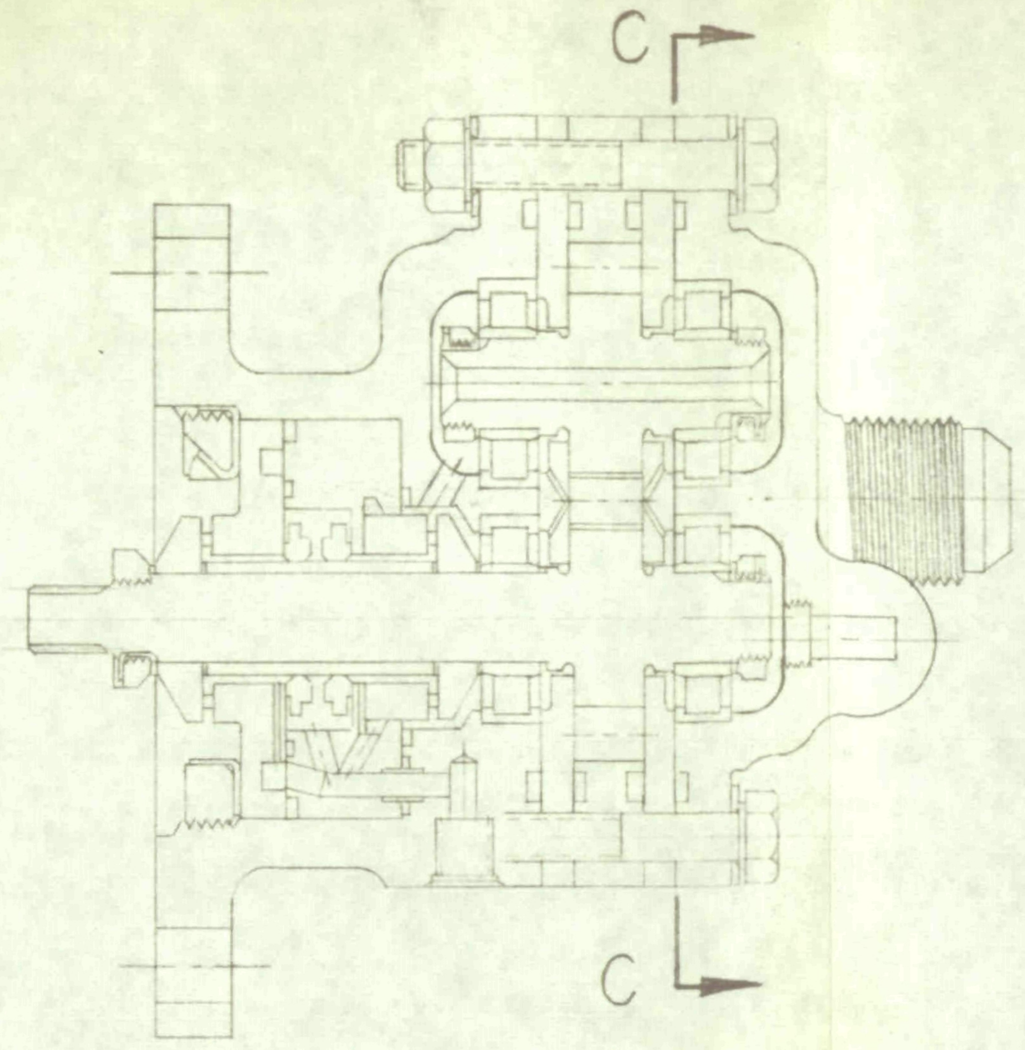
There are no current problems. Effort on the positive displacement pump has been halted pending final configuration selection by NASA. Detailing of rotating pump long lead components is currently under way; however, procurement of hardware has not been initiated pending NASA approval of the final design.

## IV. EFFORT DURING NEXT REPORTING PERIOD

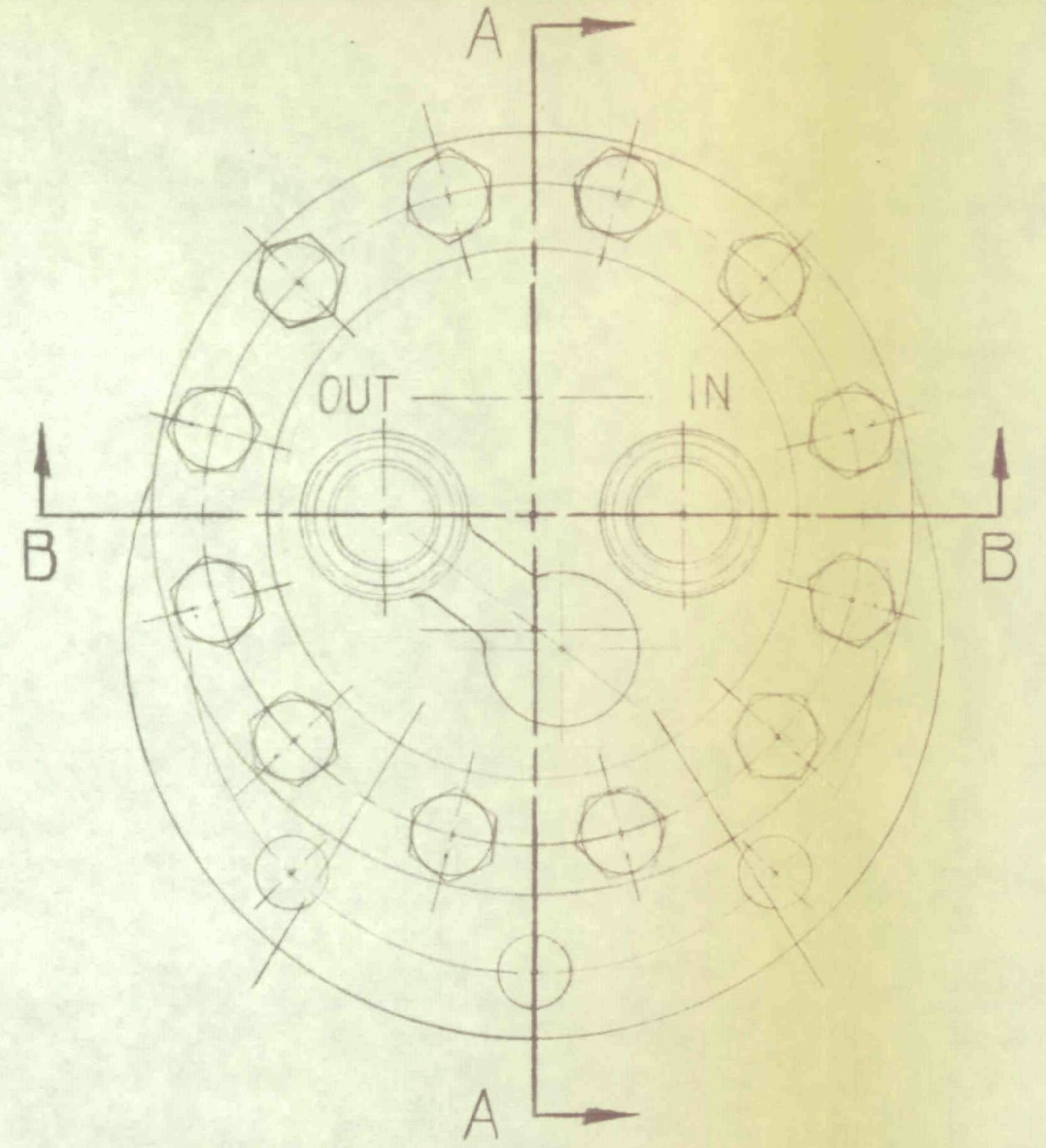
It is expected that final design of the NASA selected positive displacement pump will be initiated during the next reporting period. Work will continue on the detailing of the long lead items for the rotating pump, and it is also expected that procurement of hardware will be initiated during the next reporting period.

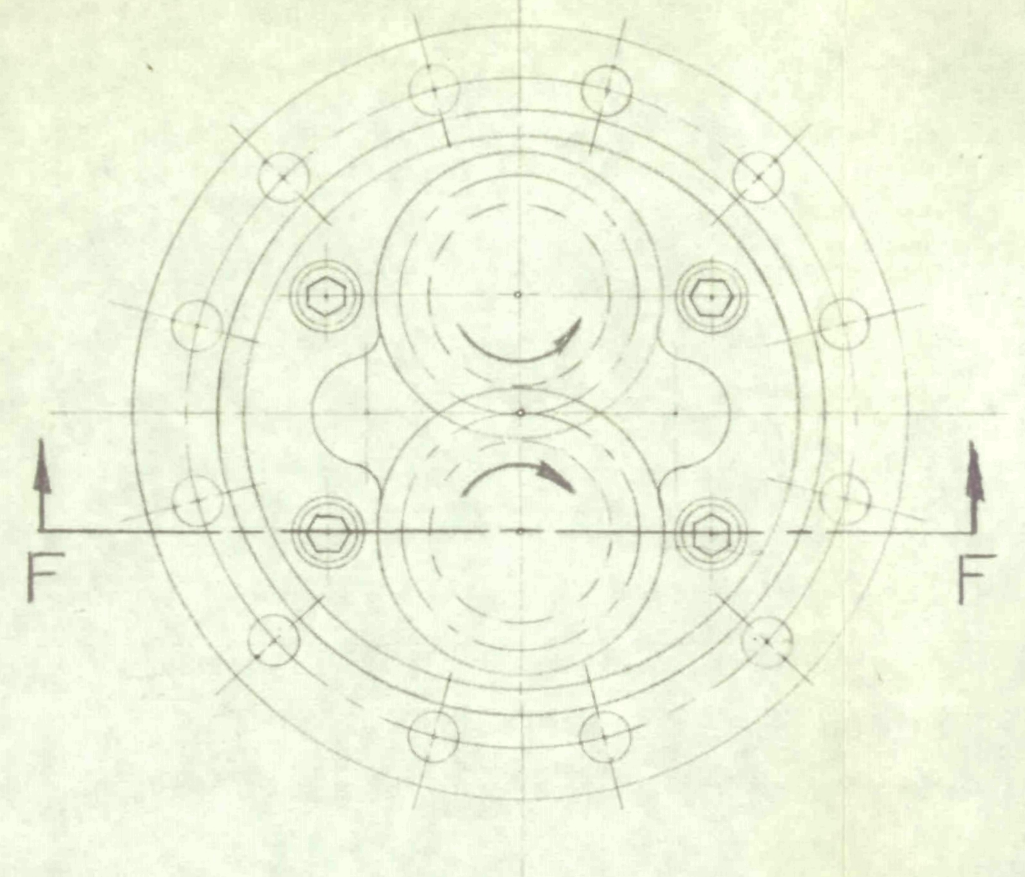


SECTION C-C

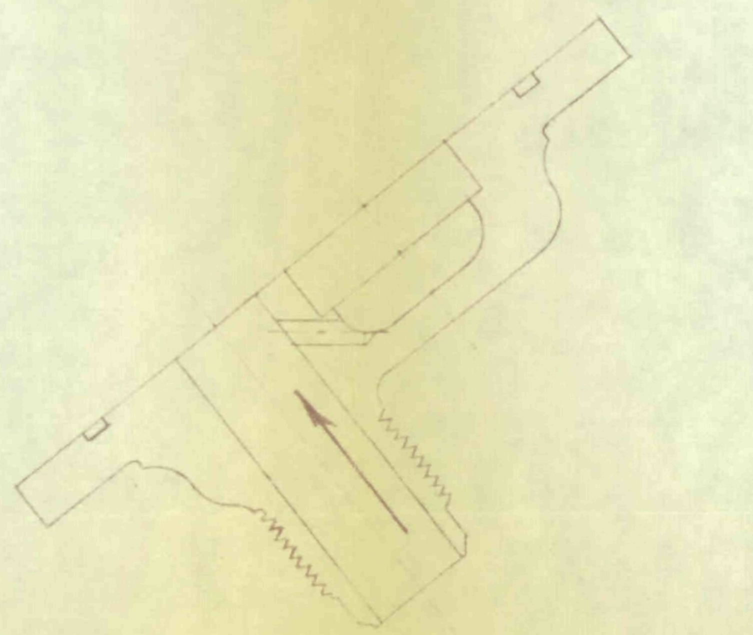


SECTION A-A

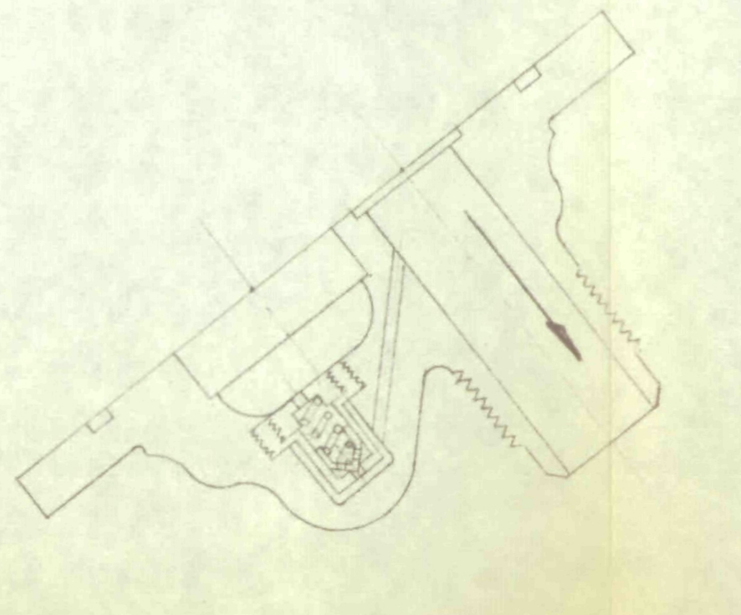




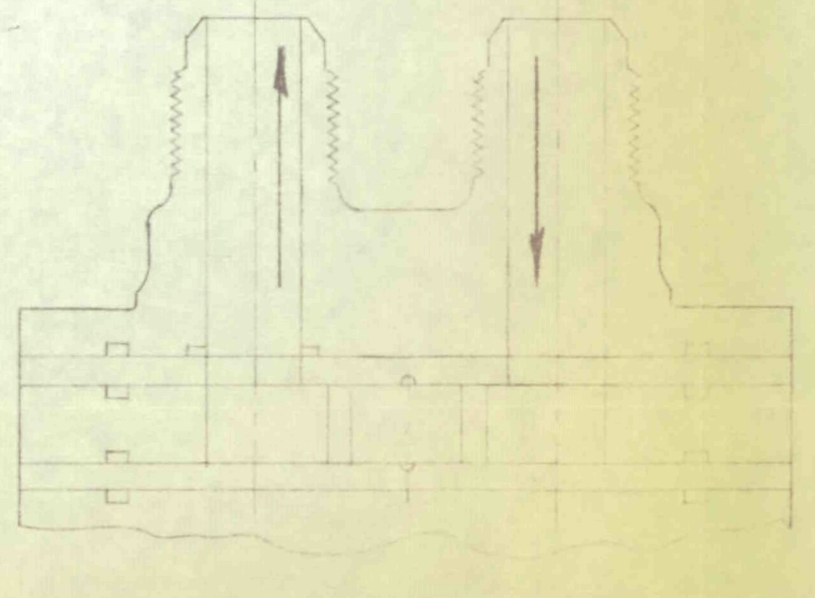
GEAR MESH



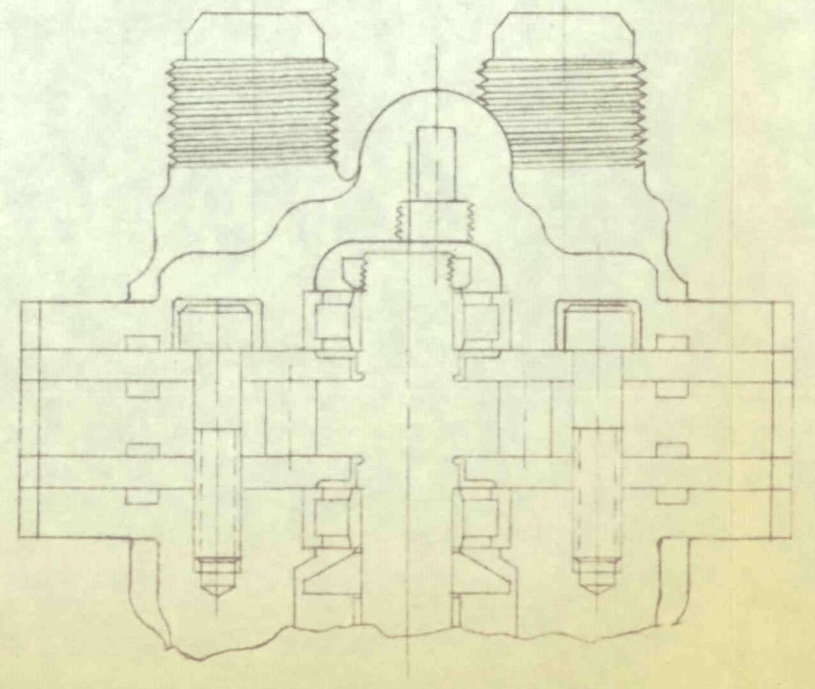
SECTION D-D
BEARING COOLANT RETURN



SECTION E-E
PRESSURE RELIEF VALVE

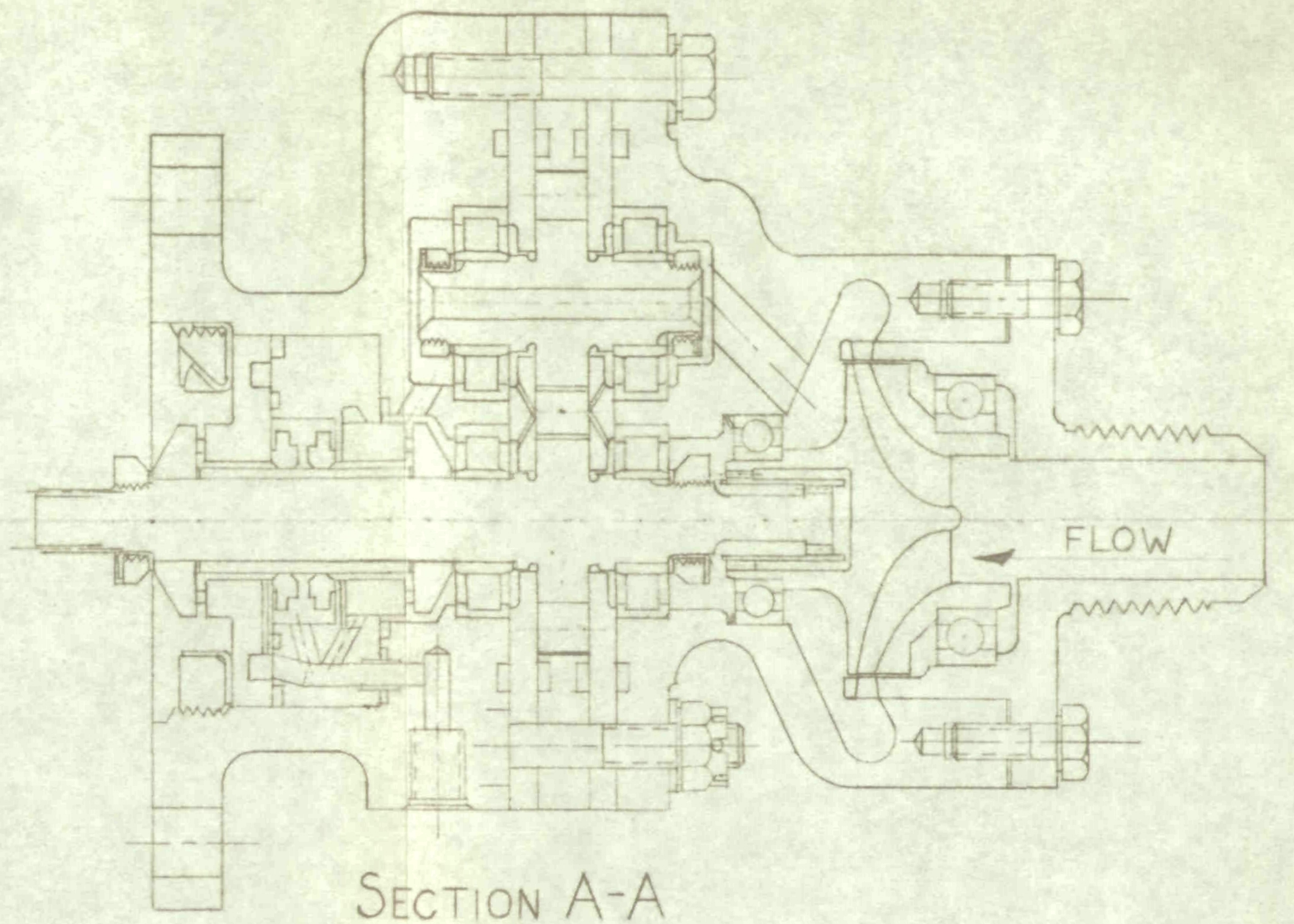


SECTION B-B

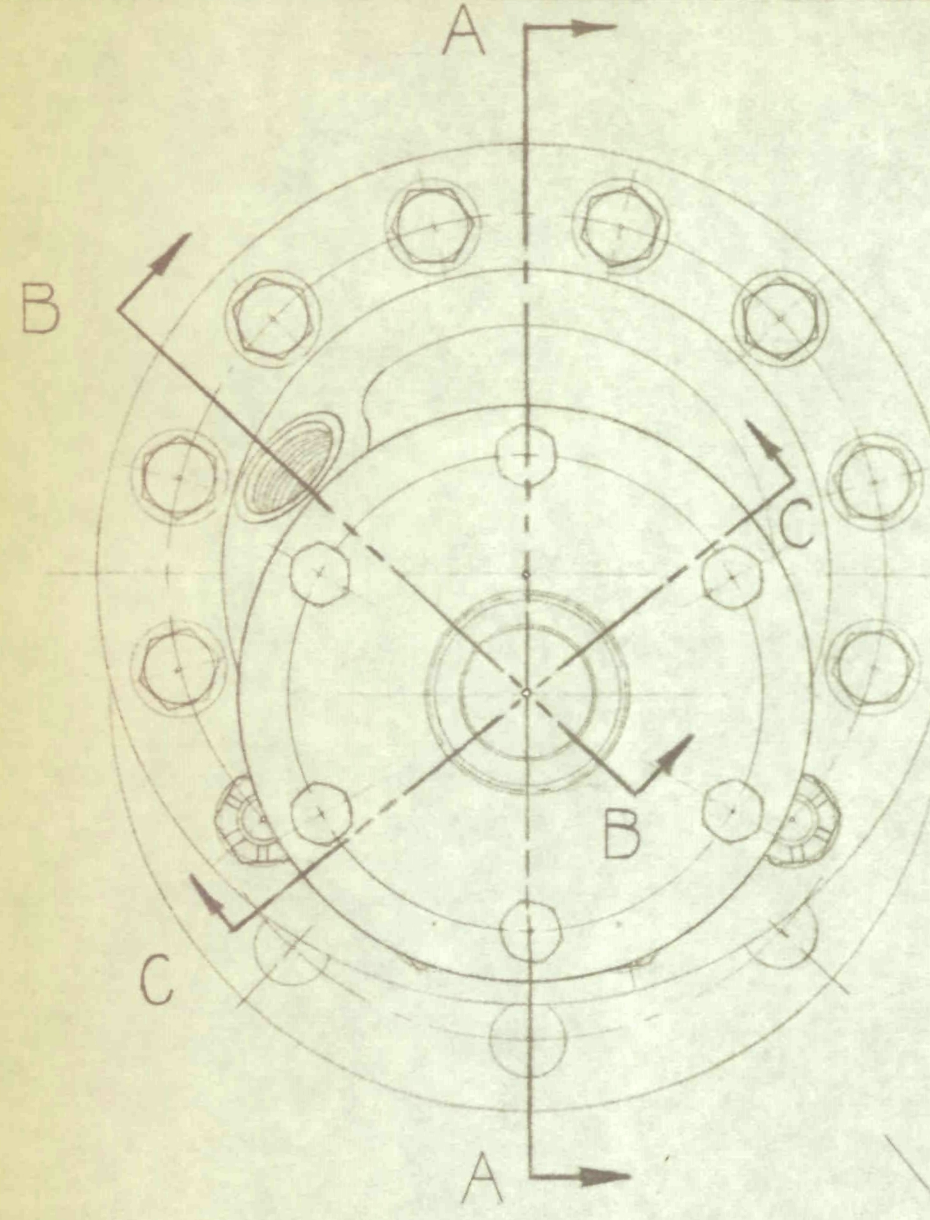


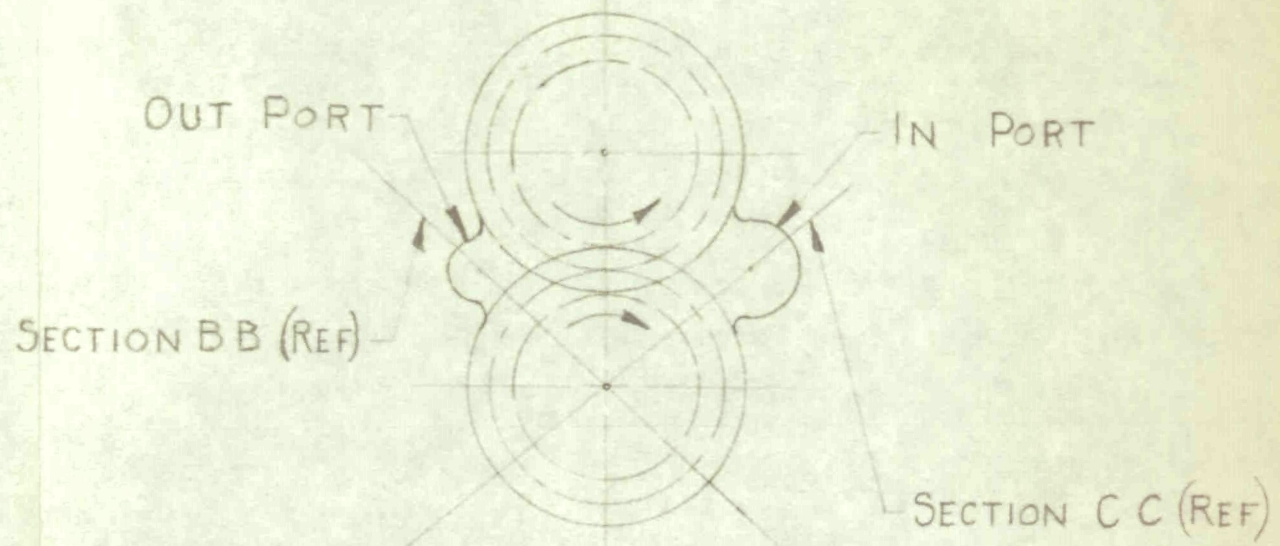
SECTION F-F

N=6,000 RPM
12 GPM GEAR PUMP
J M ZORAD 12/5/68
SCALE 1/1

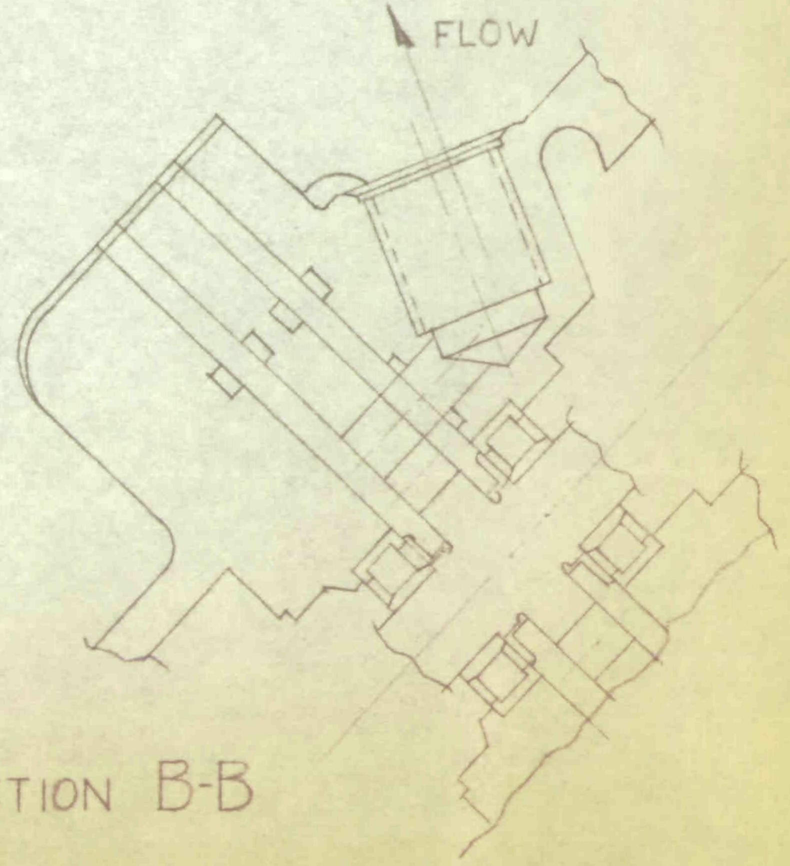


SECTION A-A

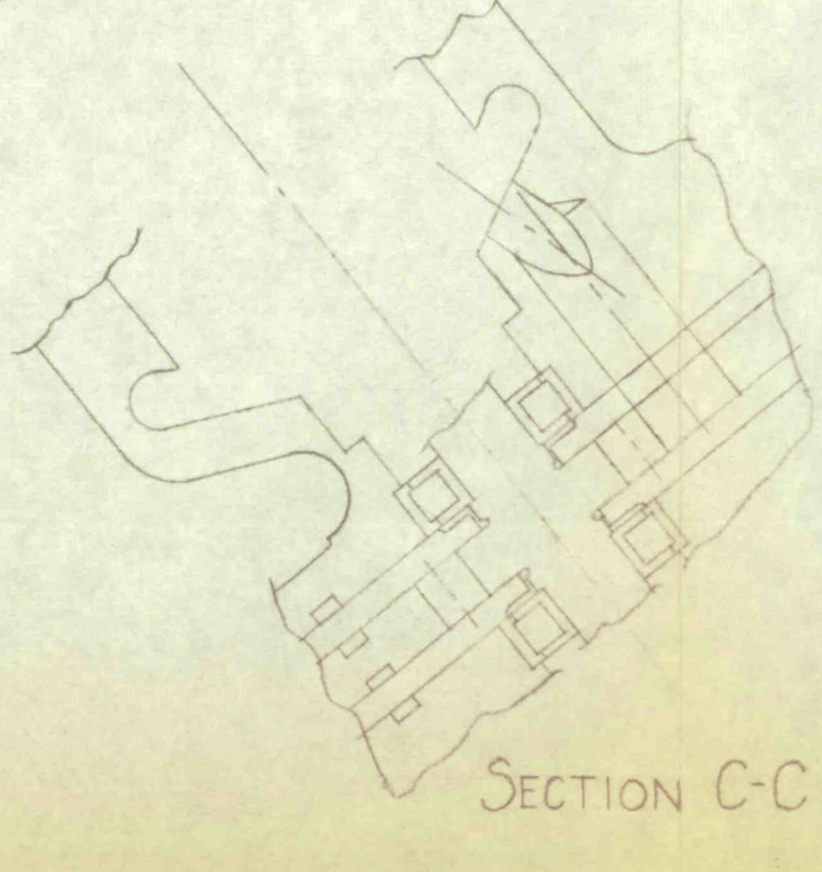



OUT PORT
IN PORT
SECTION B B (REF)
SECTION C C (REF)

GEAR MESH

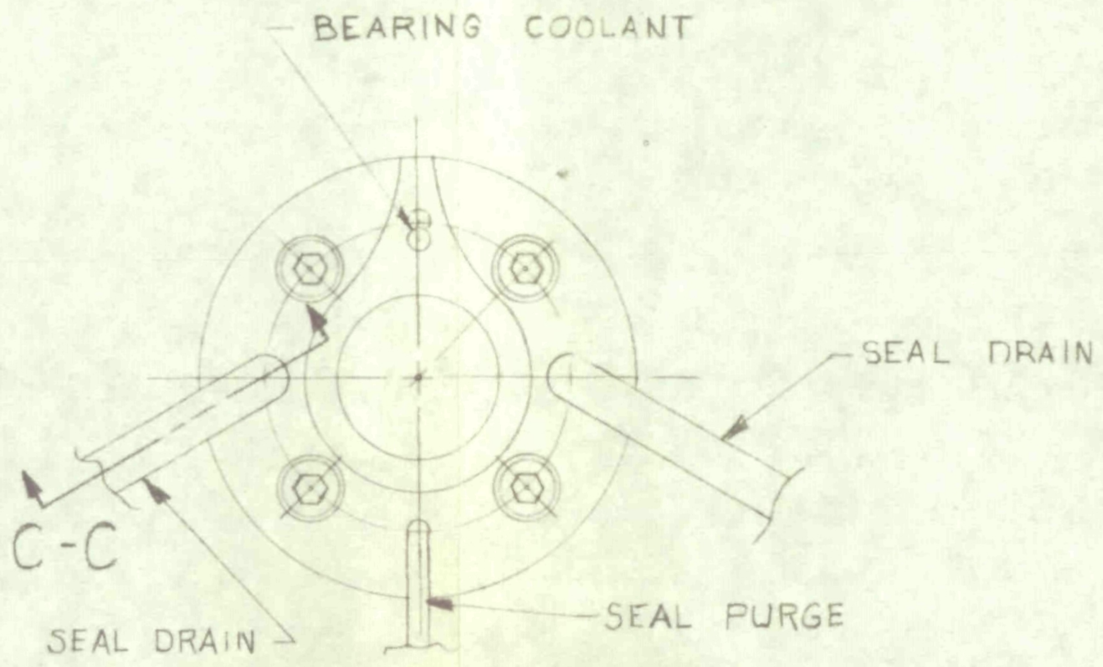


SECTION B-B

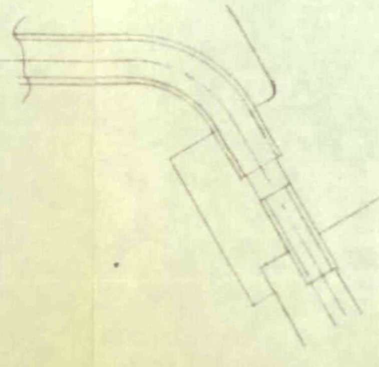


SECTION C-C

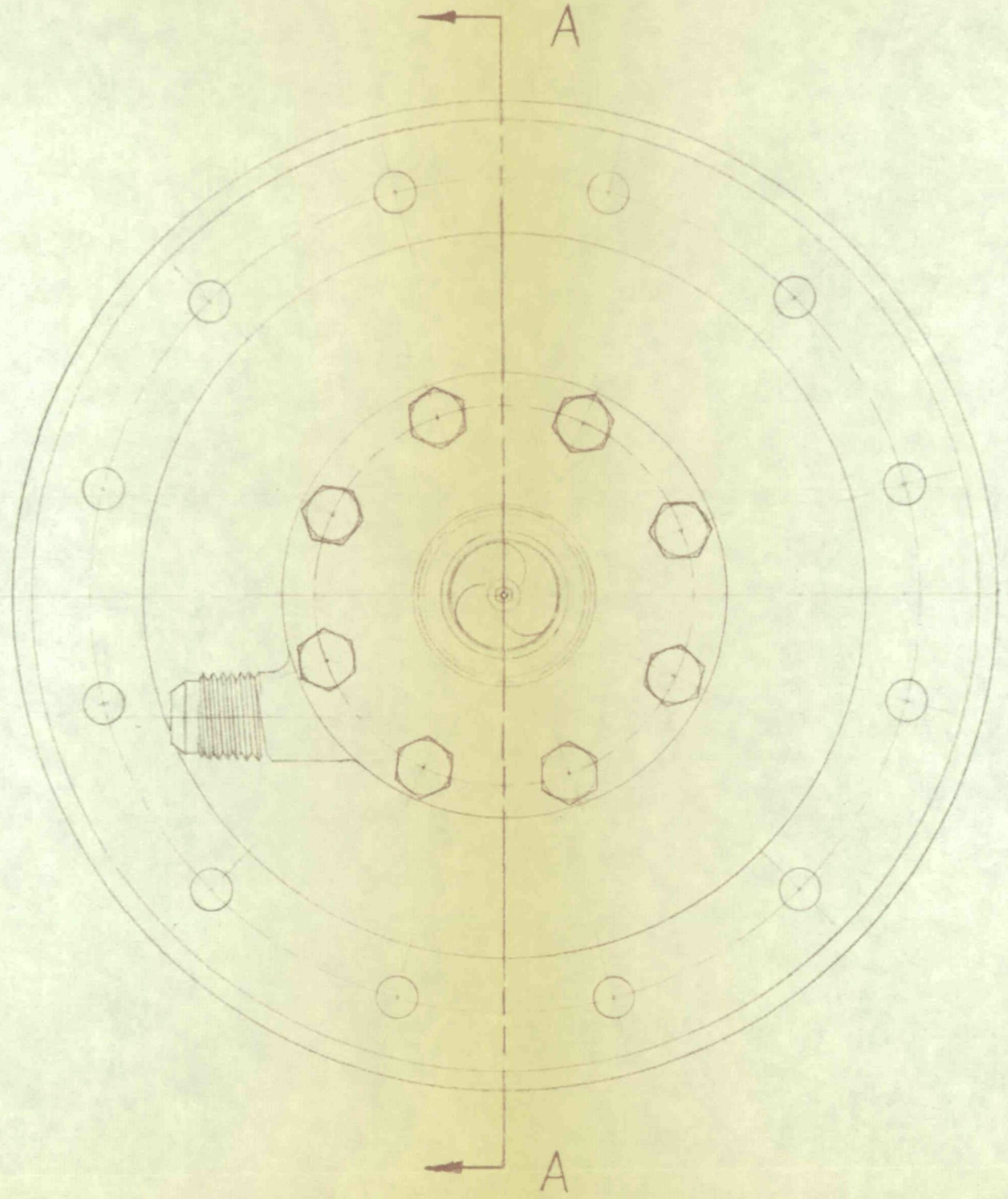
N= 8,000 RPM
12 GPM GEAR PUMP
J.M. ZORAD 11/27/68
SCALE 1/1

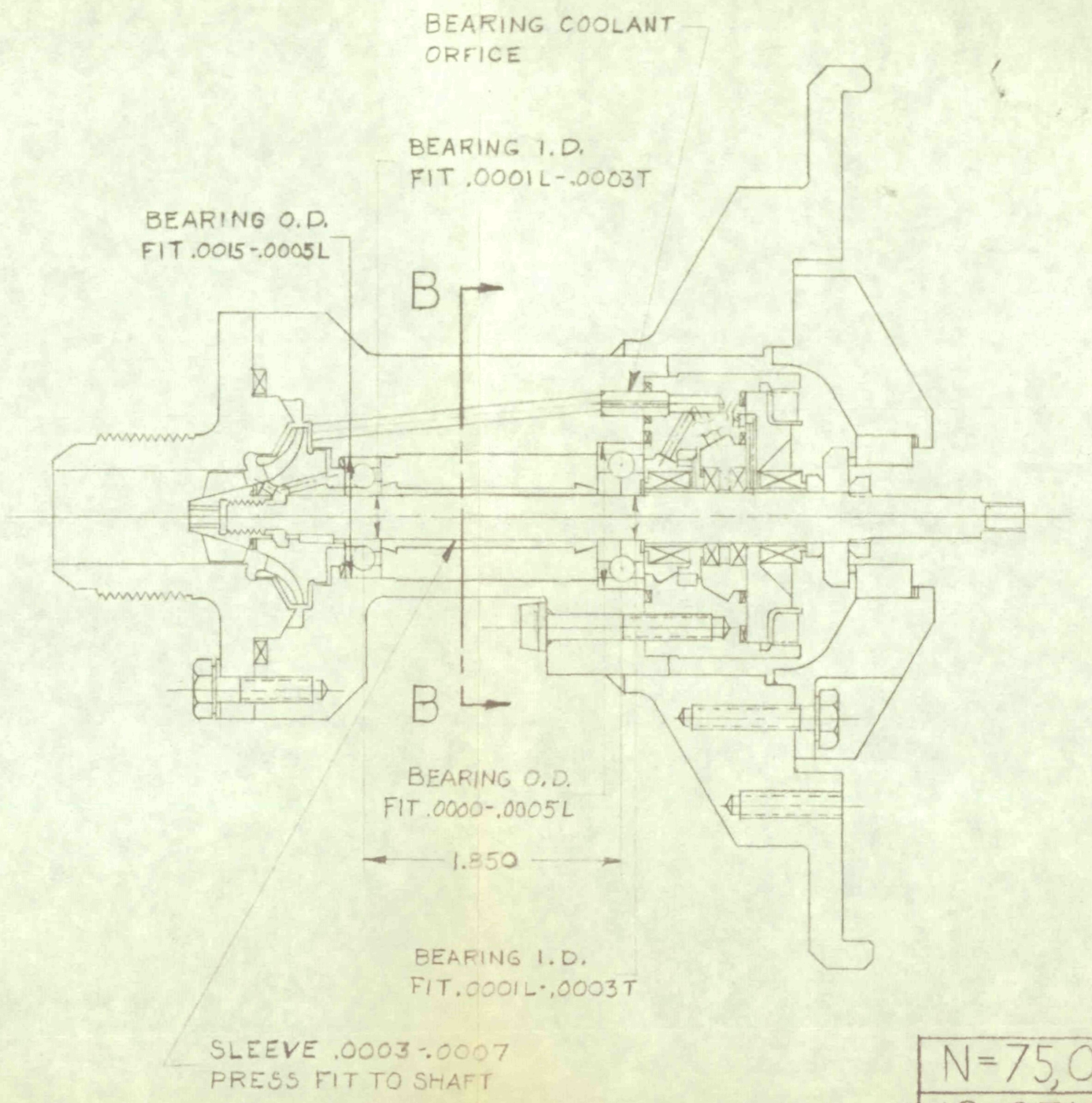

BEARING COOLANT
SEAL DRAIN
C-C
SEAL DRAIN
SEAL PURGE

SECTION B-B



SECTION C-C
TYPICAL




BEARING COOLANT
ORFICE
BEARING I.D.
FIT .0001L-.0003T
BEARING O.D.
FIT .0015-.0005L
B
B
BEARING O.D.
FIT .0000-.0005L
1.850
BEARING I.D.
FIT .0001L-.0003T
SLEEVE .0003-.0007
PRESS FIT TO SHAFT

SECTION A-A

N=75,000 RPM
12 GPM FLOW
1,500 PSI
J. M. ZORAD 12/12/68
SCALE 1=1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## CONTRACT PROGRESS SCHEDULE

REPORT FOR MONTH ENDING: Original Work Plan

FORM APPROVED. BUDGET BUREAU NO. 104-R0007

9. NASA Use Only
a. NASA CODE
b. PROJECT MGR.
c. EVALUATION DATE
d. EXCEPTION CATEGORY

1. CONTRACT TITLE: $LF_2$ Pump Program

2. CONTRACTOR (Name and address):
Rocketdyne
6633 Canoga Avenue, Canoga Park, California 91304

3. CONTRACT NO.: NAS 3-12022

4. APPROVED (Contractor's Project Manager):
E. B. Monteath
Program Manager
EB Monteath

PREPARATION DATE: 1-23-69

5. NASA APPROVED SCHEDULE DATE:

| 6. REPORTING CATEGORY | 7. 1968 | | | | | | 1969 | | | | | | | | | | | | 1970 | | | | | | 8. TECH. OBJECTIVE | e. | f. | g. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | | | | | % COMP. | | | |
| 1. Rotating Pump Evaluation | ▽ | | | ▽ | | | | | | | | | | | | | | | | | | | | | 100 | | | |
| 2. Positive Displacement Pump Evaluation | ▽ | | | ▽ | | | | | | | | | | | | | | | | | | | | | 100 | | | |
| 3. Rotating Pump Design | | | | ▽ | | ▽ | | | | | | | | | | | | | | | | | | | 100 | | | |
| 4. Positive Displacement Pump Design | | | | ▽ | | | ▽ | | | | | | | | | | | | | | | | | | 0 | | | |
| 5. Interim Report (draft) Submitted (both pumps) | | | | | | | | ▽ | | | | | | | | | | | | | | | | | 0 | | | |
| 6. Rotating Pump Procurement | | | | | | ▽ | | | | | ▽ | | | | | | | | | | | | | | 0 | | | |
| 7. Positive Displacement Pump Procurement | | | | | | | ▽ | | | | | ▽ | | | | | | | | | | | | | 0 | | | |
| 8. Rotating Pump Assembly and Checkout | | | | | | | | | | | ▽ | ▽ | | | | | | | | | | | | | 0 | | | |
| 9. Positive Displacement Pump Assembly and Checkout | | | | | | | | | | | | ▽ | ▽ | | | | | | | | | | | | 0 | | | |
| 10. $LN_2$ Tests, Rotating Pump | | | | | | | | | | | | ▽ | | ▽ | | | | | | | | | | | 0 | | | |

NASA-C-63 (Rev. 1-68)

NASA APPROVED SCHEDULE ▨
CONTRACTOR'S WORKING SCHEDULE ☐

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## CONTRACT PROGRESS SCHEDULE

REPORT FOR MONTH ENDING: Original Work Plan

FORM APPROVED.
BUDGET BUREAU NO. 104-R0007

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6633 Canoga Avenue, Canoga Park, California 91304

3. CONTRACT NO. NAS 3-12022

4. APPROVED (Contractor's Project Manager)
E. B. Monteath
Program Manager
EB Monteath

PREPARATION DATE 1-23-69

5. NASA APPROVED SCHEDULE DATE

| 6. REPORTING CATEGORY | | 7. 1968 | | | | | | 1969 | | | | | | | | | | | | 1970 | | | | | | 8. TECH. OBJECTIVE % COMP. | e. | f. | g. |
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| | | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | | | | | | | | |
| 11. $LN_2$ Tests, Positive Displacement Pump | ▨ | | | | | | | | | | | | | | ▽ | | ▽ | | | | | | | | | 0 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12. $LF_2$ Tests, Rotating Pump | ▨ | | | | | | | | | | | | | | | | ▽ | | ▽ | | | | | | | 0 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13. $LF_2$ Tests, Positive Displacement Pump | ▨ | | | | | | | | | | | | | | | | | | ▽ | ▽ | | | | | | 0 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14. Monthly Reports Submitted | ▨ | | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | | | | | | | 37 | | | |
| | | | ▽ | ▽ | ▽ | ▽ | ▽ | ▽ | | | | | | | | | | | | | | | | | | | | | |
| 15. Final Report (draft) Submitted (both pumps) | ▨ | | | | | | | | | | | | | | | | | | | | ▽ | | | | | 0 | | | |
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